

ADDENDUM TO E706EN014
PRESSURE VESSEL ENGINEERING NOTE (14.1)
LIQUID ARGON, LAC STORAGE
RD 3017, NB 85071

This Addendum is to be attached to the subject note, to provide information as to the changes made in the system.

With reference to Section 1, "Relief Valve Specifications," Note (1), the valve set pressure was changed to 30 PSIG. To facilitate this change, a new range spring was installed and tested. The results of this testing are attached to this Addendum.

The new relief valve set pressure will not affect the capacity calculations.

SU 1021

New Range Spring Installed

| Test # | 1 | 2 | 3 | 4 | 5 |
|-----------------|------|------|------|------|------|
| CRACKING PRESS. | 30.3 | 30.5 | 30.4 | 30.3 | 30.3 |
| LIFT PRESS. | 30.5 | 30.7 | 30.6 | 30.6 | 30.6 |
| RESET PRESS. | 29.4 | 29.4 | 29.3 | 29.3 | 29.3 |

SU 1022

Old Range Spring Installed

| TEST # | 1 | 2 | 3 | 4 | 5 |
|-----------------|------|------|------|------|------|
| CRACKING PRESS. | 30.3 | 30.3 | 30.2 | 30.3 | 30.2 |
| LIFT PRESS. | 30.6 | 30.6 | 30.6 | 30.6 | 30.6 |
| RESET PRESS. | 29.7 | 29.5 | 29.6 | 29.6 | 29.7 |

Full lift with the new range spring in SU 1022 was ≈ 28 psi, the adjustment screw was at full adjustment. Reinstalled the old range spring and got satisfactory results, the major difference being higher reset pressures, and a more positive lift pressure.

The cracking and reset pressures were determined by using a 0-2.0 SCFH AIR flow meter on the outlet of the valve.

A Wallace & TIERNAN 0-200 psi gauge with subdivisions of .2 was used to obtain the pressure readings & the pressure during the five tests on each valve was not allowed to drop below 28 psig

Feb. 25 1987

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II. Preparations for Cooldown

A. Pumpdown and Purge of Nitrogen Storage Dewar

1. Ensure that all pneumatic, electrical, vacuum and process flow piping on the nitrogen storage dewar and vaporizer conforms to drawing #2220.1-ME-183293, sheet 2, latest revision.
2. Check insulating vacuum to be less than 10 μ Hg on dewar jacket and the cryogenic line leading to MV-4000. Pumpdown and repair if necessary.
3. Hook up a portable vacuum pump to the relief header tap downstream of MV-4019.
4. Install a line rated for at least 300 psi from the gas tap of a 160 L portable nitrogen dewar to the drain from MV-4005 while keeping the discharge valve from the dewar closed. This line must be compatible with cold gas, adequately secured, relieved and have a provision to have the line blown down. In addition, 300 psi rated pressure regulator set at 50 psi should be installed just before MV-4005.
5. Initial valve positions:

| Closed | Open |
|---|---|
| MV-4000, MV-4005, MV-4013, MV-4019, MV-4026B, MV-4029B | MV-4006, MV-4007, MV-4008 MV-4012, MV-4020, MV-4021, MV-4022, MV-4023, MV-4024 MV-4026A, MV-4026C, MV-4028A, MV-4028B, MV-4029A, MV-4029C |
6. Open MV-4019 and pump down the dewar and its piping to 1 mm Hg or less, then shut MV-4019.
7. The rate of rise (ROR) should be no greater than 1 mm Hg/hr. Continue to pump out condensibles or repair leaks if necessary.
8. Large leaks can be found by opening both MV-4005 and the dewar valve to pressurize the dewar to 10 psig (this will require 3 full dewars) as read on PI-401. Suspect areas can then be checked using liquid soap methods. Smaller leaks must be found by pumping down the vessel and using mass spectrometer.
9. During sometime in the pumpdown, switch the position of MV-4018.
10. When the ROR is acceptable, back fill to a few psi through MV-4005 and the portable dewar valve. Shut both valves.
11. Switch MV-4018 back to its initial position.
12. Repeat step 6, then 9. Secure the vacuum pump and remove the trailer piping.

B. Pumpdown and Purge of Argon Storage Dewar and Filters

1. Ensure that all pneumatic, electrical, vacuum and process flow piping on the argon storage dewar, its condenser and vaporizer, conforms to the latest revision of drawing #2220.1-ME-183293, sheet 2.

2. Check insulating vacuum to be less than 10 μ Hg on the dewar and filter jackets. Pump down and repair if necessary.
3. Hook up a portable vacuum pump to the relief header downstream of MV-45.
4. Install a line rated for at least 300 psi from the gas tap of a portable 160 liter argon dewar (99.997 PCT purity or better) or from dewars in parallel to the utility vacuum header through either the outlet of MV-60 or MV-61. This line must: be compatible with cold gas, be thoroughly cleaned, have an adequate relief valve, be tied down securely, and have a blow down provision.
5. After ensuring that MV-2001 and MV-2003 are closed, install the jumpers connecting the liquid argon filter inlet and outlet (LAr- 9292 and LAr-9293).
6. Initial valve positions:

Closed

MV-45, MV-49, MV-50, MV-52,
 MV-60, MV-61, MV-1001, MV-1002,
 MV-1012B, MV-1012E, MV-1026,
 MV-1028, MV-1031, MV-1035,
 MV-1039, MV-2000B, MV-2000E,
 MV-2002, MV-2003, MV-2006,
 MV-2007, MV-2023, MV-2024B

Open

MV-46, MV-55, SB-59, MV-1000,
 MV-1003, MV-1004A, MV-1004B,
 MV-1005, MV-1006,
 MV1007 (capped), MV-1010,
 MV-1011, MV-1021A, MV-1012C,
 MV-1012D, MV-1012F, MV-1024,
 MV-1029A, MV-1029B, MV-1034,
 MV-1035, MV-1038, MV-1040,
 MV-1041, MV-1042, MV-2000A,
 MV-2000C, MV-2000D, MV-2000F,
 MV-2001, MV-2024A, MV-2024C,
 PV-100, EV-101*

*This solenoid might have to be overridden in order to operate PV-101. Ensure that any override is removed prior to cooldown.

7. Open MV-45 and pump down the dewar and its associated piping to 1 mm Hg or less, then shut MV-45. The pump down time can be shortened by using the utility vacuum in conjunction with the portable pump.
8. The ROR should be no greater than 500 μ /hr. Continue to pump out condensibles or repair leaks as necessary.
9. All cryogenic ball valves which are open should be closed and reopened at least once during a pumpdown to eliminate trapped gases. This should also include switching the position of the main relief three-way valve, MV-1023.
10. Large leaks can be found by first closing MV-52 (if using the UV pump), then opening both MV-60(61) and the portable dewar valve(s) to pressurize the dewar to 4 psig as read on PI-103. Suspect areas can then be checked using liquid soap methods. Smaller leaks must be found by using a HMSLD (helium mass spectrography leak detector).
11. When the ROR is acceptable, back fill to a few psi through MV-1034, MV-60(61), and the valve(s) from the portable dewar(s). Shut both valves.
12. Switch the position of MV-1023.

13. Repeat step 7, then 11. Secure the vacuum pump and remove the portable dewar piping.
14. Close MV-1007 and MV-1034.

C. Filling the Nitrogen Storage Dewar when Warm & Vaporizer Adjustment

The following assumes that part IIA has been completed.

1. Initial valve positions:

| Closed | Open |
|---|---|
| MV-4000, MV-4005, MV-4006, MV-4007, MV-4008, MV-4013, MV-4019, MV-4026B, MV-4029B | MV-4012, MV-40219 MV-4020, MV-4021 MV-4022, MV-4023, MV-4024, MV-4026A, MV-4026C, MV-4028A, MV-4028B, MV-4029A, MV-4029C |

2. Connect the supply tanker transfer line to the N₂ dewar fill connection at CV-4003.
3. First uncap the line at MV-4005, then open the supply valve at the tanker and slowly open MV-4005 until liquid N₂ is seen at the discharge, then close MV-4005.
4. Open MV-4007 slowly to start liquid transfer. The supply pressure should be maintained 50-100 psi higher than the tank pressure.
5. Monitor the liquid level using LI-401.
6. When liquid level appears at MV-4019, stop filling by closing the valve at the supply tanker. Close MV-4019.
7. Close MV-4007 and drain residual liquid by opening MV-4005. Close MV-4005 and cap end.
8. Loosen fill line to relieve pressure, then remove.
9. Open MV-4008.
10. Wait for pressures to stabilize and observe the dewar pressure as shown on PI-401. If the pressure is lower than 30 psig, then proceed to step 11; if higher than 30 psig, then proceed to step 12.
11. If the dewar pressure is below 30 psig, then loosen the pressure screw lock nut on the regulator, RV-4010. Gradually open the regulator by turning the pressure screw clockwise to build tank pressure to 30 psig. Note that the pressure screw should be adjusted in small increments, thus allowing sufficient time for tank pressure to stabilize each time the screw is turned.
12. If the tank pressure is above the desired setting, open MV-4019 to vent excess gas. Should the dewar pressure continue to rise above 30 psig, then proceed as stated below.
13. Close MV-4008 and reduce pressure until PI-401 indicates 35 psig by means of MV-4019.

14. Close MV-4008 and allow the piping from this valve to the regulator to warm up.
15. Close RV-4010 by turning the pressure screw out (counter clockwise) to the end of the adjustment range. Then close MV-4008, SLOWLY loosen SV-4009 to relieve the line pressure.
16. When the venting stops at SV-4009, remove the valve.
17. After checking PI-401 to insure that the tank is holding at 30 psig, then slowly turn the pressure screw in (clockwise) until the regulator opens (gas will flow through relief connection). Tighten the pressure screw lock nut.
18. Close MV-4012 and install SV-4009.
19. Open MV-4008 and MV-4012. The system is now ready for operation.

D. Filling the Argon Storage Dewar when Warm

The following assumes that B and C of Section II have been completed and that the liquid piping from the fill manifold to the liquid pump is leak tight. Steps 1 through 9 can be completed prior to the arrival of the delivery trailer.

1. Install the 3/4" x 2-1/2" jumper which connects the liquid nitrogen manifold to the argon storage dewar condenser piping (LN₂-9291) and the 1/2" x 2-1/2" jumper which connects the LN₂ manifold to the Rahm Cell (LN₂-9590).
2. Ensure that the vacuum jackets of the above jumpers, the liquid nitrogen manifold, and that of the liquid argon fill line (LA-9191) are down to less than 100 μ Hg.
3. Initial valve positions:

| Closed | Open |
|-------------------------------------|-------------------------------|
| MV-45, MV-1000, MV-1001, MV-1002, | MV-1004A, MV-1004B, MV-1006, |
| MV-1003, MV-1005, MV-1012B, | MV-1010, MV-1011, MV-1012A, |
| MV-1012E, MV-1016B, MV-1016E, | MV-1012C, MV-1012D, MV-1012F, |
| MV-1026, MV-1028, MV-1031, MV-1034, | MV-1013, MV-1016A, MV-1016C, |
| MV-1035, MV-1039, MV-2001, MV-2002, | MV-1016D, MV-1016F, MV-1024, |
| MV-2003, MV-2004, MV-2006*, | MV-1029A, MV-1029B, MV-1033A, |
| MV-2007*, MV-2014, MV-2015, MV-2017 | MV-1033B, MV-1038, MV-1040, |
| MV-2023*, MV-4000, MV-5008*, | MV-1041, MV-1042, MV-2000A |
| PV-100, EV-101, PV-103, PV-104 | MV-2000C, MV-2000D, MV-2000F. |

* denotes valves inside building

4. Ensure that all manual valves are closed at the utility vacuum pump and its manifold.
5. Remove all but the pivot bolt on SB-59 and spin it to the open position. Carefully center the gasket before tightening.
6. Start the utility vacuum pump and bring down the pressure at TC53 to a few microns and check that the oil level is within its operating range.

7. Open MV-52 and check the integrity of SB-59. Before repairing any leaks, close MV-52 and break the vacuum by opening MV-61.
8. Once all leaks have been repaired, the utility vacuum can be used to pump down and calibrate the Rahm Cell (refer to Part H of Section II, and Part E of Section III) if this has not already been done at this point.
9. Obtain a key to unlock MV-1026 from the Operations Center.
10. Hook up the argon trailer withdrawal line to the storage dewar fill line connection.
11. Open MV-1034, MV-1028 and pump down the portion of the argon fill line from MV-1002 to MV-2006 and MV-2007.
12. Unlock MV-1026 and open it while keeping the withdrawal valve at the trailer closed.
13. Allow the piping to pumpdown to 1 mm Hg or less and close MV-1034 at the pump manifold.
14. Crack open the withdrawal valve at the trailer SLOWLY and allow the piping to pressurize to 2 psig as read on PI-108. Close the trailer valve.
15. Open MV-1034 and pump the line down to 1 mm Hg or less, then close.
16. Repeat steps 14 and 15.
17. Again crack open the withdrawal valve at the trailer SLOWLY. When the pressure in the line as read on PI-108 reads a few psi, then open MV-1001 and close when liquid appears at the vent.
18. Close the trailer valve.
19. Test the trailer contents by following Part E of Section III at this point. Substitute MV-5008 for MV-5003. The pressure can be built up by opening the trailer valve temporarily. BE CAREFUL to keep the flow through FI-502 low so that equipment is not overcooled!
20. Compare the O_2 measurement with the one supplied by the vendor. A mole fraction greater than 0.2 ppm will not be accepted.
21. If the argon is not to be accepted, proceed to step 30 and close MV-1026.
22. The condenser can now be prepared for the dewar fill while the Rahm Cell operation is taking place. Open MV-4000 at the liquid nitrogen dewar and MV-2017 at the manifold. Set CS-104 for a level greater than zero in the automatic mode. Keep PV-100 shut by closing CS-100 in the manual position.
23. Open PV-400 and pressurize the argon condenser to 20 psig as read on PT-105. Shut EV-400.
24. Open PV-103 by using CS-103 and reduce the pressure to a couple of psi. Shut PV-103.
25. Repeat steps 23 and 24.

26. Set CS-103 to control at 2 psig and open PV-400. The condenser is now ready to cool the argon storage dewar.
27. After the electron mobility has been accepted and the condenser is ready, open MV-1002 SLOWLY to initiate filling to the dewar top.
28. The pressure in the dewar, as read on PI-103, should increase rapidly since the tank walls are warm and the condenser will take some time to cool down and fill before it can help to maintain a constant pressure. If the dewar pressure is approaching 25 psig, then throttle down on MV-1026. If the pressure still continues to climb, MV-1039 can be used to assist the condenser in keeping the pressure down. This valve should only be opened if there is adequate hearing protection available and it appears that 30 psig, the vessel relief pressure, will be reached.
29. As the dewar pressure starts to decline then one could start closing MV-1003 if open or start opening MV-1026 if throttled.
30. After the liquid load has been entirely transferred or not accepted, the supply valve at the trailer should be closed. Then close MV-1002, MV-1028 and MV-1026.
31. Open MV-1001 to bleed down the pressure, then disconnect the fill line and lock MV-1026 closed.
32. Close MV-1001 after 15 minutes and return the fill line key to the Operations Center.

E. Filling the Argon Storage Dewar when Partially Full

The following assumes that some argon is present in the storage dewar and the liquid nitrogen condenser circuit is maintaining pressure control.

1. Initial valve positions

Closed

MV-1000, MV-1001, MV-1002
 MV-1003, MV-1005, MV-1006
 MV-1012B, MV-1012E, MV-1024,
 MV-1026, MV-1028, MV-1034,
 MV-1035

Open

MV-1004A, MV-1004B, MV-1010
 MV-1011, MV-1012A, MV-1012C
 MV-1012D, MV-1012F, MV-1040,
 MV-1041, MV-1042

2. Follow steps 4 through 10 in Part D of Section II.
3. Open MV-1034 and pump down the fill manifold of the dewar.
4. Follow steps 12 through 27 in Part D of Section II.
5. Set CS-103 to control at 2 psig.
6. After the liquid has passed the Rahm Cell testing, open MV-1000 SLOWLY to initiate filling to the dewar bottom.
7. The pressure in the dewar, as read on PI-103, should increase rapidly since the tank walls are warmer than the fluid and the condenser will probably also be

warm initially. If the dewar is approaching 25 psig, then throttle down on MV-1026. If the pressure still continues to climb, MV-1039 can be used to assist the condenser in keeping the pressure down. This valve should only be opened if there is adequate hearing protection available and it appears that 30 psig, the vessel relief pressure, will be reached.

8. Level is monitored by a mechanical indicator, DPI-106, which measures the head pressure of the liquid in inches of water. A graph located in the Appendix translates a differential pressure reading into gallons.
9. The argon storage dewar level is also monitored by an electrical level indicator, LI-106, which has both a fine and coarse probe. The coarse probe, LI-106A is stationary where as LI-106B can be adjusted vertically by loosening the sealing nut located at the dewar platform. A relative level is indicated in the counting room in the form of a vertical column of lights. Each light corresponds to a liquid volume which is read from a data sheet located in the Appendix.
10. When the desirable filling level is achieved, first close the trailer valve and then close MV-1000. The maximum capacity of the dewar is 48,231 gallons.
11. Disconnect the fill line and lock MV-1026 closed after allowing the manifold to vent for 30 minutes.
12. Return the fill line key to the Operations Center.

F. Pumpdown and Purge of Argon Transfer Lines

This procedure assumes that part of D of Section II has been completed.

1. The gantry controls should be locked out at this time and the key should be left with the cryogenic supervisor.
2. Ensure that all pneumatic, electrical, vacuum and process flow piping on all argon lines conforms to drawing #2220.1-ME-183293, sheets 1 and 2, latest revision. This includes the installation of all cryogenic jumpers in both the gas and liquid transfer lines.
3. Check all insulating vacuum on the liquid argon transfer line to be less than 100 μ Hg. Pumpdown and repair if necessary.
4. Initial valve positions:

Closed

MV-49, MV-1002, MV-1006,
MV-1024, MV-1028, MV-2002,
MV-2003, MV-2006, MV-2008,
MV-3001, MV-3023, MV-5010,
MV-5012

Open

MV-1007(capped), MV-2007
MV-2023, MV-3016 (capped), MV-3025,
MV-5001, MV-5003 (capped), MV-5005,
MV-5013, EV-101, PV-100*, PV-300
PV-306

*Set to control at 2 psi in automatic.

5. Ensure that all manual valves are closed at the utility vacuum and its manifold.
6. Remove all but the pivot bolt on SB-50 and spin it to the open position. Carefully center the gasket before tightening.

7. Start the utility vacuum pump and bring down the pressure at TC53 to less than 100 microns and check that the oil level is within its operating range.
8. Open MV-52 and check the integrity of SB-50. Before repairing any leaks, close MV-52 and break vacuum by opening MV-60.
9. Once all leaks have been repaired, the utility vacuum can be ready for use.
10. Open MV-49 and pump down piping from MV-1002 at the storage dewar through MV-3025 at the LAC and ultimately back to the storage dewar at MV-1006.
11. When the pressure in the piping is 1 mm Hg or less, then shut MV-49.
12. The ROR should be no greater than 1 mm Hg/hr. Continue to pump out condensibles or repair leaks if necessary.
13. Large leaks can be found by opening MV-1024 to pressurize the piping to 4 psig as read on PI-51 (PV-100 setting may be increased temporarily). Suspect areas can then be checked by using liquid soap methods. Smaller leaks must be found by pumping down the lines and using a HMSLD.
14. When the ROR is acceptable, backfill to a few psi through MV-1024. Close MV-1024.
15. Repeat steps 10, 11 and 14.
16. Open MV-2008 and MV-2009. Keep a flow through the liquid pump by cracking MV-1024.
17. After flowing for a couple of minutes, close MV-2008 and open MV-2006 for about 20 seconds or so, then close.
18. Close MV-2009 at the argon pump and MV-1007 and MV-3016 on the gas makeup line.

G. Pump and Purge of the LAC Vessel and Components

The following assumes that part F of Section II has been completed and that all penetrations are closed and seals made up. It has also been assumed that the main relieving vent piping is attached and properly routed to the outdoors. All ODH alarms should be energized and verified to be functioning properly.

1. LAC Volume initial valve positions:

Closed

MV-8, MV-63, MV-66, MV-1006
 MV-3001, MV-3004, MV-3020B,
 MV-3020E, MV-3021B, MV-3021E,
 MV-3023*, MV-3025, MV-3039B,
 MV-3039E, MV-5001, PV-100,
 PV-309

Open

MV-64, MV-65, MV-1031**, MV-3007,
 MV-3008, MV-3012, MV-3013,
 MV-3015A, MV-3015B, MV-3015C,
 MV-3018A, MV-3018B, MV-3018C,
 MV-3019A, MV-3019B, MV-3019C,
 MV-3039A, MV-3039C, MV-3039D
 MV-3039F, MV-3042, MV-3044,
 MV-3045, MV-3046, MV-3047,
 MV-3048, MV-3049, MV-3050,
 MV-3051, MV-3052, PV-306